A TIME SERIES ANALYSIS OF POST-WAR FLUCTUATIONS IN SHIPPING FREIGHTS

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A TIME SERIES ANALYSIS OF POST-WAR FLUCTUATIONS IN SHIPPING FREIGHTS[1]

By Hiroyuki YAMADA*

I Problems and Method

When we discuss the business cycle in ocean shipping, the indicators we most commonly employ are the Index of Tramp Shipping Freights, and Index of Tramp Time Charter Rates or Index of Tanker Freight Rates, which are published monthly by the Chamber of Shipping of the United Kingdom or the Norwegian Shipping News. But people usually use these indices without sufficient knowledge about the nature of these economic indicators, namely as to what sort of movement these freight indices inherently trace. More concretely, no sufficient analysis has ever been made as to what extent these indices follow seasonal fluctuations, or whether there is any trend in the movement of these indices, or how are the period and amplitude of cycle, or whether it is susceptible to irregular factors etc.; nor has hardly any study been made of the interrelation among these various freight indices, except the analysis of Lewis[2], which treated the interrelation between voyage charter rates and time charter rates.

If, however, the business cycle in ocean shipping is to be analysed, it is, above all, essential to rearrange and compile the time series data selected as business cycle indicators, according to some consistent method; and to grasp what nature these freight indices have as time series, and to know the interrelation among them when more than one time series are to be studied.

The freight indices published monthly are, of course, rearranged and compiled according to some method. But the method employed there is simply an arrangement of cross section data, that is, average freight rates for various routes and cargoes in the period of one month, and as a time series it is only the ratio of such average freight rates against that of a specific base period. So, if one attemps to analyse the business cycle in ocean shipping from such an index, it is necessary to rearrange and

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1) Valuable suggestions were given by Prof. Masao Baba (Institute for Economic Studies, Kyoto University) in starting this study, while I owe much to Mr. Tomoyoshi Doi (Japan Shipping Research Institute) for the utilization of an electronic computer. I wish to express hereby my gratitude to them.

2) W. A. Lewis, The Interrelation of Shipping Freights, in *Overhead Cost*, 1949.

compile the freight index of such time series by some appropriate method in order to isolate cyclical elements as much as possible. Particularly, when monthly (and quarterly) data are to be analysed, it is necessary for us to adjust seasonal variations and it does present to us a specific problem.

When the nature of the freight index as a time series is to be grasped from such standpoint, what sort of method is to be applied? One of the traditional methods frequently used is to regard the monthly freight index (R_t) as being composed of 4 elements, namely, seasonal component (S_t), trend component (T_t), cyclical component (C_t) and irregular component (I_t). These components can be treated as additive factors as in the case of (1) or as multiplicative factors as indicated by equation (2)[3].

(1) $R_t=S_t+T_t+C_t+I_t$

(2) $R_t=S_t \cdot T_t \cdot C_t \cdot I_t$

This method is applicable when one attempts to isolate an economic indicator from others and analyse the nature of its fluctuations independently, instead of trying to see their interrelations and causal relations, and it has been developed in connection with the extraction of cyclical movements.

The basic characteristic of this method lies in its attempt to separate *mechanically* the 4 components constituting an economic indicator, by some statistical method. However, this attempt itself involves a serious problem. Are these 4 elements really *mechanically* separable? These 4 components influence each other and the distinctions between them are not always clear. The component which presents least problem is the seasonal component. It is the variation which repeats itself with the period of 12 months and therefore the pattern of its variation is quite inflexible. So it is the easiest to isolate. On the other hand, the trend, cyclical and irregular components have no specific and obvious pattern as in the case of seasonal component. The trend, cyclical fluctuation or irregular fluctuation are caused by the intensity and persistence of various factors which influence the demand and supply position of the market. Therefore, whatever complicated method may be employed, the mechanical separation of 4 components is not absolutely trustworthy. If one evades a cause and effect analysis or looking into interrelation analysis and resorts only to the method of mechanical separation of 4 components, he can not escape the criticism that it is "a measurement without theory"[4].

If these limitations are well kept in mind, one may utilize the statis-

3) Equation (2) can be converted to additive factors if logarithms are used, but the writer indicated equation (2) here as this paper is based upon the equation (2).

4) T. C. Koopmans, "Measurement without Theory", *Review of Economic Statistics*, Aug. 1947.

tical information obtained by such method to enrich our knowledge about economic indicators. The deeper comprehension of the nature of economic indicators is necessary to lay a foundation for more advanced analysis. The purpose of this paper also lies in the analysis of the nature of shipping freight indices and the analysis of business cycles in ocean shipping, by utilization of statistical information obtained by application of the aforementioned procedures.

The method employed in this paper for such analysis is "the Bureau of Census Method II"[5] which was developed by J. Shiskin et al. of the Bureau of Census, U. S. Dept. of Commerce and National Bureau of Economic Research. It is based upon the ratio-to-twelve-month-moving-average method. It was originally devised for the seasonal adjustment of monthly data, but it also separates the cycle-trend component and irregular component in a consistent manner and also takes into account the average monthly amplitudes of various components, thus presenting the statistical information which is useful for analysing the nature of a given economic indicator. In this sense this Bureau of Census Method exactly meets our purpose.

This method still entails the following problems[6]. The specific feature of this method is that the computation of moving seasonal adjustment factor is made on the assumption that the pattern of seasonal fluctuation does change. So the seasonal adjustment factor obtained by repeated computations of the weighted moving average shows a fairly smooth fluctuation as indicated in Figure 2. This is because the Bureau of Census Method II is based on the further assumption that the pattern of seasonal fluctuation changes only smoothly and gradually. Therefore, in such cases where (1) the seasonal pattern drastically changes due to institutional or natural causes, (2) the seasonal pattern undergoes great change because of a strong cyclical movement, (3) the amplitude of seasonal variation varies considerably from year to year, (4) the irregular fluctuation is very serious, etc., the seasonal indices obtained by this method have only a limited effect on adjustment. This point must be taken into account also when the seasonal fluctuation of shipping freights is analysed. Besides, in detecting the cyclical fluctuation we must pay attention to the "Slutsky-Yule effect" which says that the moving average brings about a regular oscillation even when the original series shows an irregular one. There is another problem in that the timing of the turning

5) As regards "the Bureau of Census Method II", refer to J. Shiskin, Electronic Computers and Business Indicators, in *Business Cycle Indicators*, ed. by H. Moore, Vol. I, 1961.

6) Cf., M. Baba, "Recent Developments regarding Seasonal Fluctuation Adjusting Method" (in Japanese), *the Humanities (Jinbun)*, Department of Liberal Arts, Kyoto University, Vol. IX, 1963.

point of the cycle may shift off by the moving average. In this regard, Spencer's 15-term formula which is used as the weight in the weighted 15-term moving average for calculation of the trend-cycle component, is claimed to be a superior method as it concentrates 65% of its total weight upon the central 3 terms[7]. This will be referred to later.

These problems always present themselves as long as the moving average method is employed. Therefore when we utilize the statistical information obtained by the Bureau of Census Method which frequently uses the moving average method, we should always keep in mind that it involves these problems.

II Comparison of Freight Indices and Their Natures

The shipping business indicators, the object of analysis in this paper, are the monthly tramp shipping freights index (voyage charter rates index), time charter rates index and tanker freight rates index which have been published monthly by the Chamber of Shipping of the United Kingdom and Norwegian Shipping News, since the end of the Second World War. Using these indices as original series, the calculation steps of

Table 1. Data (Business Indicators of Ocean Shipping)[8]

	Period	Number of Months
Index of tramp shipping freights (Chamber of Shipping, U. K.)[9] (1952=100)	Jan. 1950– Dec. 1961	144
Index of tramp time charter rates (Chamber of Shipping, U. K.) (1952=100)	Jan. 1952– Dec. 1962	132
Index of voyage charter rates (Norwegian Shipping News) (Latter half, 1947=100)[10]	Jan. 1947– Dec. 1962	192
Index of time charter rates (Norwegian Shipping News) (Latter half, 1947=100)	Jan. 1947– Dec. 1962	192
Index of tanker freight rates (Norwegian Shipping News) (USMC=100)	Sept. 1949– Dec. 1962	160

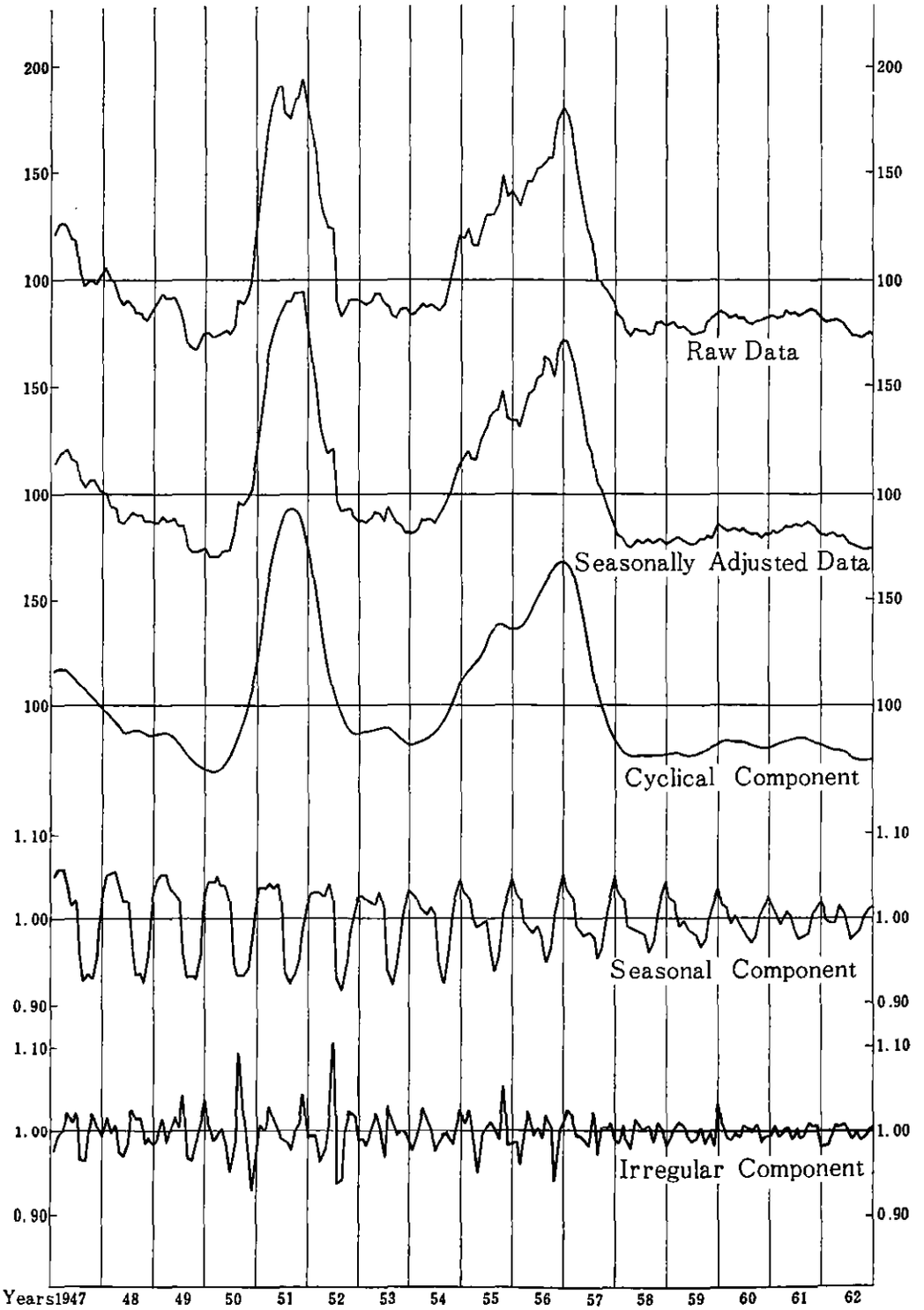
7) The weight of Spencer's 15-term formula is, $\frac{1}{320}(-3, -6, -5, 3, 21, 46, 67, 74, 67, 46, \cdots)$.

8) The Bureau of Census Method II has 11 programs of electronic computer, namely X-0 to X-10. The tramp shipping freights index of the Chamber of Shipping of the United Kingdom was computed by X-0, and other indices were computed by X-10.

9) The basis of index calculation of the Chamber of Shipping of the United Kingdom was changed in 1952 and 1960. The figures shown here are converted to those of 1952 year basis.

10) The basis of calculation is not clear with the indices of Norwegian voyage charter rates and time charter rates, but the base period is fixed at Jul.-Dec. 1947, so that there is no need of conversion and it is excellent in view of its continuity. Therefore we used the Norwegian voyage charter rates figure to illustrate the result of computation.

Figure 1. Fluctuation of Voyage Charter Rates Index (Norway)



the Bureau of Census Method II were followed and the seasonal adjustment factor, seasonally adjusted series, cyclical component, and irregular component were calculated in the above order. Figure 1 shows one example of the result of calculation, which is the seasonally adjusted series and its components of the original series of Norwegian voyage charter rates index[11].

Then the average monthly amplitude was calculated as to the original series, seasonally adjusted series and their components. Since the average monthly amplitude is the average of the month-to-month percentage change without regard to sign, it gives the clue to the judgement concerning the size of fluctuation of each series and the degree of contribution of each component to the fluctuation of the original series. Therefore it gives the very convenient statistical information for the analysis of the nature of the fluctuation of each index. Now let us compare and examine various indices using this average monthly amplitude as the main criterion, paying attention also to the results of other computation.

The average monthly amplitude of each index in each series is shown in Table 2. From this table we can find the following facts.

1. Time charter indices show greater amplitude of fluctuation than voyage charter indices.
2. The freight rates which show the greatest fluctuation are tanker freight rates. Such marked fluctuation is brought about by seasonal and irregular components.
3. The freight rates which are most severely affected by seasonal fluctuation are tanker rates. Tanker rates show the smallest $\bar{I}/\bar{S}$ and the largest $\bar{S}/\bar{C}$. In the other indices, the amplitude of the seasonal component is the smallest. This means that the tanker rates index has a different fluctuation pattern from other indices.
4. The freight rates which show the relatively remarkable cycle-trend component are the Norwegian voyage rates. They show the smallest value for $\bar{I}/\bar{C}$ and the largest one for $\bar{C}/\bar{O}$. It can be inferred from the above that the influence of the irregular and seasonal components upon Norwegian voyage rates is relatively small, consequently the influence of the cyclical component is relatively pronounced.
5. The two British indices and Norwegian time charter index show the largest amplitude of the irregular component, followed by the amplitude for the cyclical component and the amplitude for the seasonal component. The three indices show roughly the same pattern.

11) As for the results of computation of other indices, refer to Hiroyuki Yamada, "The Fluctuations of Shipping Freights after the World War II" (in Japanese), *Journal of Japan Shipping Research Institute*, No. 21, Feb./Mar. 1964.

In these indices, the effect of the irregular component is the strongest and as for the other two indices the effect of the irregular component is the second largest. This means that the shipping freights are apt to be affected by irregular or contingent factors.

Using these findings as clue, let us analyse the nature of the shipping freights fluctuation.

Table 2. Average Monthly Amplitudes of Shipping Freights Indices and their Relations

Series	Raw $\bar{O}$	Seasonally adjusted $\overline{CI}$	Irregular $\bar{I}$	Cyclical $\bar{C}$	Seasonal $\bar{S}$	$\bar{I}/\bar{C}$	$\bar{I}/\bar{S}$	$\bar{S}/\bar{C}$	$\bar{I}/\bar{O}$	$\bar{C}/\bar{O}$	$\bar{S}/\bar{O}$
Tramp shipping freights, U. K.	5.30	4.76	3.34	2.96	2.89	1.13	1.16	0.97	0.63	0.56	0.55
Time charter rates, U. K.	6.84	5.94	4.23	3.77	2.98	1.12	1.42	0.79	0.62	0.55	0.44
Voyage charter rates, N. S. N.	3.51	3.04	1.93	2.29	1.76	0.84	1.10	0.77	0.55	0.65	0.50
Time charter rates, N. S. N.	6.05	5.40	3.83	3.80	2.65	1.01	1.45	0.70	0.63	0.63	0.44
Tanker freight rates, N. S. N.	12.34	10.48	8.02	5.03	9.31	1.59	0.86	1.85	0.65	0.41	0.75

It is well known that the time charter index shows greater fluctuation than the voyage. This can be readily inferred from the fact that in a prosperous period the time charter index rises over the voyage index and in a depressed period it drops below it. The fact that the time charter index fluctuates more than the voyage is more clearly shown by the Norwegian indicators than by British indicators. (Cf. the figures of original series of Table 2.) This can be explained by the particularly small amplitude of irregular fluctuation in the Norwegian voyage charter index. As for British indicators, the factor which contributes to the increase of amplitude is firstly the irregular component and then the cyclical component. Therefore we can say that the causes of the larger amplitude of fluctuation of time charter rates are mainly due to the irregular component.

Then let us pay attention to the fact that the tanker rates index fluctuates more severely than the time charter and that such fluctuation is primarily caused by the seasonal component. Of course the contribution of the irregular component is also significant since the amplitude of seasonally adjusted series is as large as 10.48. As for tanker rates, we can refer to the example of the application of the Bureau of Census Method II to the free tanker local market[12]. From this example we can see that local tanker rates fluctuate almost identically with the Norwegian index and that the freight rates which are contracted in local markets

12) Sun Oil Company, Economic Department, *An Analysis of Gulf-East Coast Tanker Charter Rates, 1948–1962*, 1963.

are understood to be strongly influenced by the freight fluctuations in the world shipping market. When we compare the two amplitudes of the original series of the local freight and the world, we can see that the amplitude of fluctuation is larger in the local market than in the world since the average amplitudes $\bar{C}$ of the two cyclical components are almost identical.

Table 3. Monthly Average Amplitude of U. S. Gulf/U. S. East Coast Tanker Freight

	Original Series $\bar{O}$	Seasonal Adjustment $\overline{CI}$	Cyclical $\bar{C}$
Clean	14.99	12.69	5.05
Dirty	15.37	13.38	5.42

From the above it has been made clear that what causes the difference in amplitude of fluctuation of the freight rates is mainly the irregular component, if the seasonal component of tanker rates is set aside. When we combine the two facts, i.e., the fact that the amplitude of fluctuation is larger for the time charter market than for the voyage charter market, for the tanker market than for the time charter market, and for the local tanker market than for the world tanker market; and the fact that the size of the market is smaller for the time charter market than for the voyage charter market, that the free tanker market is even smaller and that the local free tanker market is the smallest, we can see that the fluctuation becomes greater as the size of the market becomes smaller. Besides, from the fact that the increase of amplitude is mainly caused by the irregular component, we can conclude that the smaller the size of the market, the more susceptible are the freight rates to the irregular variations.

Here we should not overlook the fact that the irregular component as defined here accords with the definition of the Bureau of Census Method II. To clarify this point let us look at the average duration of runs. The average duration of the run is the average number of consecutive monthly changes in the same direction. From Table 4 it is observed that the cyclical component continues to move to the same direction for 8, 9 months on the average, while the irregular component changes the direction of movement every 1 or 2 months. Thus the factors which cause irregular variations are those which vary very quickly in a short period. The factors which bring about such movement may be speculation or other psychological factors. For example, the non-economic factors which affect the demand and supply position such as war or political turmoil may function as the irregular component. But if such a non-economic factor continues to force the market in the same direction over several months, it will become a factor to cause the cyclical movement, according to the statistical operation of the Bureau of Census Method.

On the other hand, even when such a non-economic factor influences the market in a month as an irregular factor, in the following month or two months later there appears another factor which forces the market in the other direction and according to the Bureau of Census Method such force towards the opposite direction is also treated as an irregular component. In short, what is called irregular here is the movement which continuously changes the direction at random.

Table 4. Average Duration of Run (Tramp Shipping Freights, U. K.)

Seasonally adjusted series	2.65 months
Cyclical component	8.94
Irregular component	1.66

Such relationship is made clearer by contrasting the irregular component with the cyclical component. Their values of a given month are compared to the value of one, two, three and more months before and the averages of the absolute values of the percentage changes for one-, two-, three-month and longer spans are computed. The ratios of the average amplitudes of the irregular to the cyclical factors are computed for various spans. Table 5 shows such amplitudes and ratios. According to Table 5, as for the irregular component, no significant change of average amplitudes is observed regardless of the span, while as for the cyclical component, as the span increases, the average amplitude also becomes larger. This means that in the same phase of the business cycle, the cyclical movement does accumulate. The irregular-cyclical ratio $\bar{I}/\bar{C}$ for both British tramp shipping freights and Norwegian time charter rates becomes less than 1 in the 2nd month. It means that

Table 5. Average Amplitude by Monthly Span

Monthly Span	(British Voyage Charter Rates)			(Norwegian Time Charter Rates)		
	Irregular $\bar{I}$	Cyclical $\bar{C}$	$\bar{I}/\bar{C}$	Irregular $\bar{I}$	Cyclical $\bar{C}$	$\bar{I}/\bar{C}$
1	3.34	2.96	1.13	3.83	3.80	1.01
2	3.94	5.91	0.67	4.63	7.50	0.62
3	3.98	8.81	0.45	4.43	11.10	0.40
4	3.46	11.64	0.30	3.91	14.60	0.27
5	3.27	14.40	0.23	3.61	17.99	0.20

the "Number of Months for Cyclical Dominance"—MCD Span— is 2 months. In the case of Norwegian voyage charter rates, one can easily see that MCD span is 1 month, from the value of $\bar{I}/\bar{C}$ of Table 2 (= 0.84). From these facts we can draw the following conclusion. When we try to see the cyclical fluctuation from the seasonally adjusted series, we can utilize the Norwegian voyage charter rates as they stand, but as for British tramp shipping freights or Norwegian time charter rates, it is

better to take the average of two-month span. Therefore, when the cumulative effect is taken into account, the weight of the cyclical fluctuation is also significant.

Thus the cyclical component has a considerable weight next to the irregular component and the weight of seasonal component is the least. This is the general nature of all price indices. According to the report of Shiskin[13], as regards the 18 series of the principal economic indicators in the U.S.A., the seasonal component is predominant and out of the 18 series, 13 series show the larger monthly average amplitude of seasonal component than that of the cyclical component, while as for price indices, the opposite is the case. Next to the seasonal component in weight is the irregular component and in 12 series out of the said 18, the average amplitude of the irregular component is superseding the amplitude of the cyclical component. Therefore the voyage charter rates and time charter rates have a fluctuation pattern similar to price indices, while the tanker rates have a pattern similiar to the other general economic indicators. In this sense, the tanker rates index could possibly be a peculiar index as a price index. On the other hand, the Norwegian voyage charter rates have the opposite peculiarity in that they give the largest weight to the cyclical component.

III Seasonal Element in Shipping Freights Fluctuation

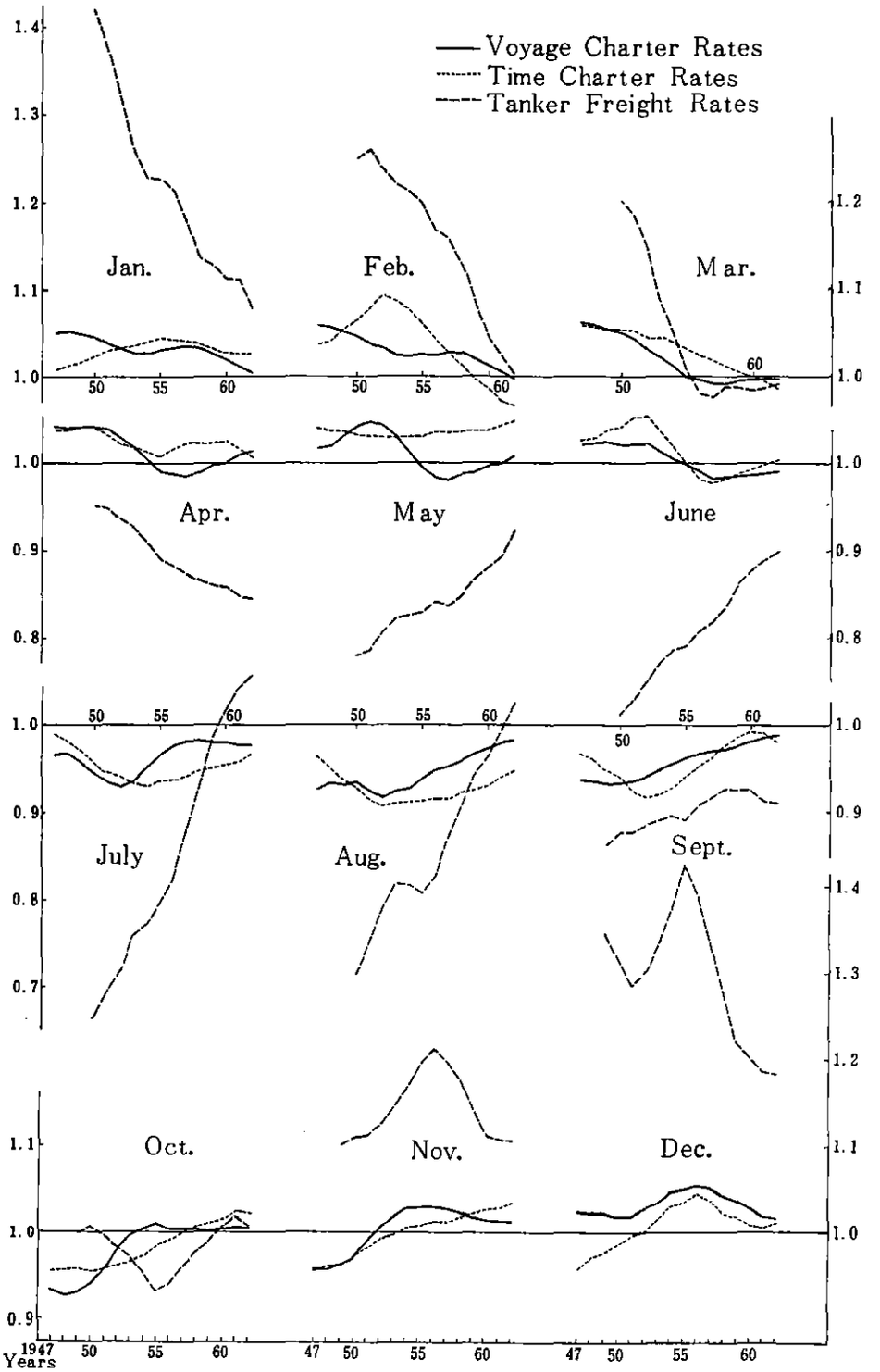
It has been made clear that as regards the great effect of the irregular component there is no substantial difference between tramp (voyage and time charter) rates and tanker rates, but as to the influence of the seasonal component a contrasting difference is observed between the two. The seasonal factor strongly influences the tanker rates, but as for the tramp rates the effect of the seasonal factor is the least of all 3 components. This does not mean, however, that the seasonal factor has no effect upon the tramp rates. From the graphs of seasonal variation illustrated in Figures 1 and 2, we can detect the influence of the seasonal factor even upon the Norwegian voyage charter rates, which show the smallest value for it.

In this section we will analyse the seasonal variation in view of the results of computation obtained by the Bureau of Census Method II, which is most appropriate for the computation of seasonal adjustment. Figure 2 is the graphic illustration of the movement of the monthly seasonal index. Now we will focus our attention on the Norwegian voyage charter rates whose data are taken for the longest period of time.

The pattern of seasonal variation of Norwegian voyage charter rates

13) Shiskin, *op. cit.*, pp. 536, 539.

Figure 2. Transition of Monthly Seasonal Index (Norwegian Index)



is not uniform in the period of 16 years from 1947 to 1962, but it is considerably varied. Nevertheless, the phenomena of summer slump and winter briskness are generally observed. The lowest seasonal index is shown mostly in August, then follow July, September and October. The month in which the seasonal index becomes the highest is most frequently December and then November, January, February and March. But as it is evident from Figure 2, the seasonal index of August, September and October is ascending gradually and the phenomenon of the summer slump is becoming less conspicuous. On the other hand, the seasonal index of January, February and March is gradually decreasing and the phenomenon of winter briskness is also becoming attenuated. It is known therefore that the amplitude of seasonal fluctuation is decreasing year by year. This is also clear in Figure 1.

In contrast to this, the factor which changes the pattern of seasonal variation is the seasonal index in spring, i.e., March, April and May. From 1947 through 1950, the seasonal index in March is the highest throughout the year. It is a conspicuous busy-spring phenomenon. While as time goes on, the seasonal index of spring gradually decreases and around 1955 it completely disappears. In contrast, the seasonal index in autumn, i.e., in October and November is less than 1 in the earlier period but it gradually increases and since 1954, it has increased beyond 1 showing an autumn briskness.

To summarize the above, taking 1954 and 1955 as the turning point, the seasonal pattern changes from summer slump and winter-spring briskness pattern to summer slump and winter-autumn briskness pattern. But since about 1960, the seasonal index of April and May has been again increasing beyond 1.

The seasonal variation of British voyage charter rates also agrees with that of Norwegian voyage charter rates and no substantial difference was seen between the two. Just occasionally the movement of British index leads the Norwegian index by about a month.

The seasonal variation of Norwegian time charter rates sometimes leads the voyage charter rates by about one or two months, but it follows roughly the same pattern with voyage charter rates. As for time rates, the diminution or disappearance of spring briskness was not observed as it was for voyage rates. The seasonal index of May does not show much change throughout the period, as seen in Figure 2. It is generally over 1.03 but since 1959 it shows the highest seasonal index.

British time rates show roughly the same seasonal fluctuation as Norwegian index, but the phenomenon of spring briskness is changing from less remarkable to more remarkable. As far as this point is con-

cerned, it shows the similar movement to the voyage charter index rather than to the Norwegian time charter index. The amplitude of seasonal fluctuation of time charter rates during 1951 to 55 is larger than in the preceding period, but since 1956 it has been gradually diminishing.

The question here is that the voyage charter rates show remarkable spring activity until about 1950, but they have curved down gradually since then, until again in the 1960's they returned to a higher level, while as for Norwegian time charter rates no such phenomenon is observed. This may be explained by the fact that in spring the ocean transportation is generally brisk and the demand for shipping space is vigorous and is well reflected in the time charter market while it was not well reflected in the voyage charter market in the mid 1950's. However, British time charter rates show the similar movement to the voyage charter rates. So it is not a justifiable explanation, when we further take into account that the movement of seasonal index shows a turn in the mid 1950's. We may have to interpret it in the light that, owing to the great cyclical fluctuation culminating in the Suez boom, the seasonal variation of freight rates has been strongly influenced and is reflected here after being somewhat levelled off by the moving average process which is used many times in the Bureau of Census Method.

As stated in Section I, the Bureau of Census Method stands on the assumption that the pattern of seasonal variation changes smoothly. Therefore if the seasonal variation is greatly changed owing to the strong effect of a business cycle, the seasonal index becomes unreliable. As is well-known, the main cargoes of the tramps are ores and grain, in addition they also carry various bulky cargoes, and different commodities have different times of maximum activity. For example, grains are shipped largely in spring but coal moves in autumn and winter. The tramp shipping freights index is the average or the combination of various cargo freights, therefore its movement becomes more complicated. In order to clarify the above point, it must be necessary to analyse the coal rate or grain rate as independent series. Whatever it may be, it is certain that in the mid 1950's some structural change or disturbance took place.

Unlike the tramp rates, the seasonal variation of tanker rates is much simpler. Not only because the amplitude of seasonal variation is large, but also because the seasonal pattern is also fixed. It has a set pattern of spring-summer slump and winter briskness. It may be because the tanker is specially engaged in the transportation of one kind of cargo, oil. It is noteworthy, however, that in the 1960's, the phenomenon of the summer slump has been disappearing. Also as regards tanker rates, the amplitude of seasonal fluctuation is diminishing. Since the

amplitude has been quite large, the diminution is conspicuous. As is evident in Figure 2, the indices of January, February, March and April are decreasing consistently, while those of May, June, July, August and September are increasing and this trend is contributing to diminish the amplitude. Also in the case of tanker rates, there is a turn in the index of October, November and December around 1955–56. There it turned up or down. These phenomena also contributed to diminish the seasonal fluctuation. In regard to this turning of trend, we also have to take into account the fact that the Suez boom reached its peak in December 1956.

As seen above, there is an evident contraction of the amplitude of seasonal fluctuation of tanker rates but it still shows a big seasonal variation even today when compared to the tramp rates. Therefore when the cyclical fluctuation of tanker rates is analysed, the seasonal adjustment should be done by all means. In the analysis of tramp rates, it is of course necessary to make seasonal adjustment. Now we come to the stage where we should take up the cyclical fluctuation which is the main subject of this thesis.

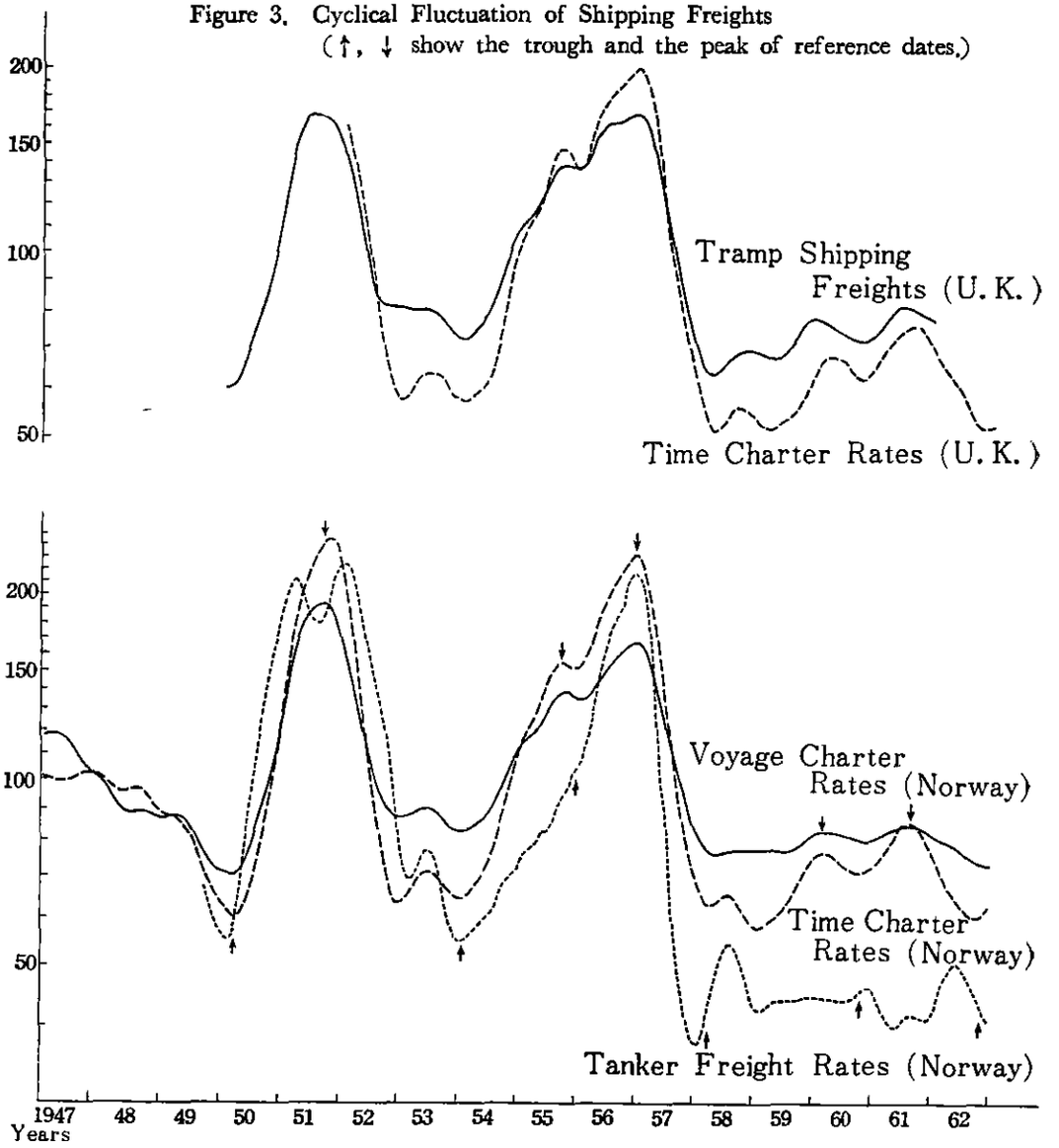
IV Cyclical Fluctuation of Shipping Freights

In this Section the characteristics of cyclical fluctuation of post-war freight rates are to be made clear. In such case, the first problem to be taken up is how often the post-war shipping business has experienced business cycles and how long the duration of each cycle was. The second problem is whether several shipping freight indices fluctuate concomitantly or if there is a lead and lag relation among them. In this connection, it is necessary to study whether the following conclusion which Lewis arrived at by analysing the relation between voyage charter rates and time charter rates during the period between the two Wars could be applied to the post-war fluctuation: "The two markets (voyage charter and time charter markets) are connected and rates move together. But time charter rates fluctuate more widely than voyage charter rates. When conditions are improving, long rates (time charter rates) rise more rapidly than short rates. When conditions are deteriorating, owners at first hold out, so that the voyage rates fall more quickly than the time, and it is only later that the longer rates fall to a corresponding level[14]." The third problem is what amplitude and pattern the freight cycle has.

Now, in order to show what kind of cyclical fluctuation each index takes, cycle-trend curves are given on a logarithmic scale in Figure 3. Since there is no secular trend for each index as clearly shown by the graph, let us treat them as indices to show the cyclical movement.

14) Lewis, *op. cit.*, p. 93.

Figure 3. Cyclical Fluctuation of Shipping Freights
(↑, ↓ show the trough and the peak of reference dates.)



In order to clarify the above problems, it is necessary first of all to decide the *reference dates*, showing the months when the business cycle reached troughs and peaks[15]. In our method, the correct determination of the reference dates has a basic significance. It is therefore necessary to set them up carefully. We decided the *reference dates* according to the following timing rules by using both seasonally adjusted series and cyclical components calculated by the Bureau of Census Method II.

15) Here, we decided the reference dates of shipping business based on the shipping freights index. However, it is rather preferable to decide the reference dates from the business fluctuation of the world economy as a whole. If so, it would be possible to analyse the *reference cycle* of the shipping freights. In the analysis below, the *specific cycle* in A. F. Burns and W. C. Mitchel, *Measuring Business Cycles*, 1947, was referred to.

First, we selected the turning point from downward to upward, *trough*, and the one from upward to downward, *peak*, for both of seasonally adjusted series and cyclical components. Then for each turning point, we decided as reference date for shipping freights cycle as a whole, if turning months of many indices coincide, that month, or if they do not coincide, the month which comes closest to the center, referring mainly to the cyclical component. But we do not consider as one cycle such period as is within 15 months from trough to trough or from peak to peak.

One thing which has been clarified by means of these works is that the voyage charter rates and time charter rates fluctuate almost in the same way — this will be studied further in detail as the second problem —, whereas the tanker rates show fairly independent movement from the two. (Refer to Table 7). It was therefore decided to determine the reference dates of peak and trough by 4 series of indices excluding tanker rates index. This is shown in Table 6 (and in Figure 3 with ↓, ↑). The reference dates shown here are therefore the dates of freights cycle relating chiefly to the tramp market. Another point is that the discrepancy of timing between the turning point of cyclical component and that of seasonally adjusted series concerning four indices except the tanker rates index, is not so great. In almost one half of the cases, the dates for peak or trough coincided with each other between the two series. For three fourths of the remaining cases, the discrepancy was one month, and for the rest, two months.

Now, Table 6 shows the reference dates of ocean shipping and the duration of each cycle clarified based on them. By this Table, it is shown that the post-war shipping freights fluctuation had 5 cycles from March 1950 to October 1962, and their average duration was about 30 months. This result corresponds to the following understanding of the post-war

Table 6. Reference Dates and Duration of Shipping Freights Cycle

Reference Dates			Duration (Months)		
Trough	Peak	Trough	Rise	Fall	Full Cycle
Mar. 1950	Sept. 1951	Jan. 1954	18	28	46
Jan. 1954	Sept. 1955	Dec. 1955	20	3	23
Dec. 1955	Dec. 1956	Mar. 1958	12	17	29
Mar. 1958	Feb. 1960	Oct. 1960	23	8	31
Oct. 1960	Aug. 1961	Oct. 1962	10	14	24
Average			16.6	14.0	30.6
Average deviation			4.4	6.8	6.4

freight rates fluctuation.

First, the boom right after the end of World War II was followed by the recession through 1948–1949, which hit the bottom in March 1950 to start the first cycle. This cycle was what was influenced by the Korean War which broke out in June 1950. It arrived at a peak after the truce was proposed by Maric in June 1951 and then started to decline. The problem as to this cycle is to decide the date of the trough which put an end to this cycle. A confusion is caused because at the end of 1952 all indices turned upward after having gone through the trough and then came across the trough again at the end of 1953 or the beginning of 1954. It took about one year. In view of the rule not to consider a wave short of 15 months as a cycle as mentioned before, this wave does not constitute a cycle. When each index is examined, except Norwegian time charter rates of which the index had a deeper trough at the end of 1952 than at the beginning of 1954, all other indices marked the lowest level at the beginning of 1954. Taking also into account the fact that the Korean truce was concluded in July 1953, we decided to consider January 1954 as the trough which marked the end point of the first cycle.

The wave which started in 1954 and reached the peak at the time of the Suez Crisis is generally understood to be one cycle. But here, we take it in 2 cycles, before and after the Suez Crisis. This is because the latter was the fluctuation brought about mainly by the special political factors of the Suez Crisis, whereas the rising phase prior to the Suez Crisis was principally based on the general boom of Western Europe and the cold war; these two are different in their nature. It is therefore considered more reasonable to distinguish them from each other as two cycles. All indices reached a peak around September 1955 and showed a decline, though brief, from then to the end of 1955 or the beginning of 1956. This made it possible to make a distinction between the two cycles.

The third cycle which started at the beginning of 1956 reached its peak in December 1956 when the Suez Crisis was at its climax, and then entered a phase of sharp decline. In this case again, it is questionable when was the trough which marked the end of the cycle, because, except for the index of Norwegian voyage charter rates, all other indices once arrived at their bottom around the beginning of 1958, and then after experiencing a small peak, encountered again the trough at the beginning of 1959. Particularly, in the case of Norwegian time charter rates, the trough at the beginning of 1959 was deeper than that of the spring 1958, and it hit the lowest post-war level. On the other hand, British index

of voyage rates (as well as the tanker rates index) had a deeper trough at the beginning of 1958. It should therefore be concluded that the third cycle ended in March 1958 and thence the fourth cycle started.

In such case, the fourth cycle should be considered to have had its peak at the beginning of 1960 and its trough in October 1960, because the duration is less than 15 months from the spring 1958 to the beginning of 1959. The fifth cycle consists of its rising phase from October 1960 to the summer 1961 and its declining phase from the summer 1961 to the fall of 1962. It is interesting that we can find two cycles, even if weak, in the period of excess tonnage after the Suez boom.

Thus the post-war shipping freights fluctuation from March 1950 to the end of 1962 is divided into 5 cycles which have their individual characteristics. The average duration of each cycle is about 30 months, so it becomes somewhat similar to a so-called *minor cycle.* However, by this analysis, it is impossible to clarify whether the longer cycle a *major cycle* exists[16]. Naturally, it is still hardly possible to analyse such a longer cycle only with post-war data but it is an important result of our analysis that we can find the existence of a *minor cycle.*

The rising phase lasts on average for about 16 months and it should be noted that its duration is relatively stable, its average deviation being about 4 months. On the other hand, the declining phase is on average for 14 months. The rising phase is on average longer than the declining phase. But the average deviation of the declining phase is bigger, and if its average duration excluding the particularly short declining phase

Table 7. Lead and Lag of Each Indx (Seasonally Adjusted)

Reference Dates	Tramp Freights (U. K.)	Time Charter Rates (U. K.)	Voyage Charter Rates (Norway)	Time Charter Rates (Norway)	Tanker Rates (Norway)
Trough Mar. 1950			−1	0	−1
Peak Sept. 1951	−4		+1	+2	+6
Trough Jan. 1954	−1	0	0	0	−1
Peak Sept. 1955	+1	−1	+1	0	−2
Trough Dec. 1955	−1	0	+2	−1	−2
Peak Dec. 1956	0	+1	+1	0	+2
Trough Mar. 1958	−2	+1	+1	+9	−3
Peak Feb. 1960	−1	+1	−2	+1	(Jul. 1958)
Trough Oct. 1960	0	0	0	0	(Sept. 1961)
Peak Aug. 1961	−1	+2	+1	+2	(May 1962)
Trough Oct. 1962		0	0	−1	0

16) Cf., S. A. Metzler, Review of Burns and Mitchell, Measuring Business Cycle, in *Readings in Business Cycles and National Income,* 1953.

of the second cycle is taken, it becomes about 16 months and coincides with that of the rising phase.

The second problem is to examine the lead and lag relations among the shipping freights indices. Table 7 shows the lead and lag relations between the reference dates of freights cycle which are already decided, and the seasonally adjusted series of each index. (When the turning point of the seasonally adjusted series leads the reference dates, it is indicated by " − ", while the lag is indicated by " + "). From this Table, it can be seen that all indices except that of tanker rates moved almost in the same way and the only exception is that in Norwegian time rates the trough ending the 3rd cycle lags by 9 months behind the reference date, as will be referred to later. However, relatively speaking, there is a tendency for British voyage rates to take a little lead. As Lewis pointed out[17], this would be because the voyage rates incorporated in the index are often *future* rates rather than *spot* rates.

Now, is it here possible to apply Lewis's conclusion mentioned before, to the post-war fluctuation? The former half of his conclusion, "Voyage charter rates and time charter rates move together, but when conditions are improving, long rates (time charter rates) rise more rapidly than short rates", seems to be applicable to the post-war fluctuation judging from Figure 3. However, its latter part, "When conditions are deteriorating, the voyage charter rates fall more quickly than the time charter rates, and it is only later that the time charter rates fall to a corresponding level" is only applicable to the third cycle of the post-war fluctuation; that is, though the voyage rates hit their lowest level at the beginning of 1958, the time rates fell to a trough after 3 months in the case of British index, and after 8 months in the case of Norwegian index. But the declining phase of the first cycle was contrary to this; the time rates marked their lowest level at the end of 1952 whereas the voyage rates reached their lowest level only at the beginning of 1954. In all other cycles, both indices reached the turning point almost at the same time. It can be said, therefore, that Lewis's proposition about the declining phase does not apply to all cases and the declining phase in which Lewis's proposition hold is the severe one after a great boom like the Suez boom.

Although the tanker rates showed far more complicated movement than other indices, they moved more or less together with other indices up to the third cycle. However, it should be noted that after the third cycle, they showed fairly independent movement from other indices. (Refer to Figure 3 and Table 7).

17) Lewis, *op. cit.*, p. 92.

Table 8. Amplitude of Specific Cycle—Voyage Charter Rates (Norway)

Dates of Specific Cycles	3-Month Average in Specific Cycle Relatives Centered on			Amplitude of			Per Month Amplitude of		
Trough – Peak – Trough (1)	Initial Trough (2)	Peak (3)	Terminal Trough (4)	Rise (5)	Fall (6)	Rise & Fall (7)	Rise (8)	Fall (9)	Rise & Fall (10)
Feb. 50 – Oct. 50 – Jan. 54	60.8	167.0	70.7	106.2	95.3	201.5	5.6	3.5	4.4
Jan. 54 – Oct. 55 – Feb. 56	72.2	124.3	118.3	52.1	5.0	57.1	2.5	1.2	2.3
Feb. 56 – Jan. 57 – Apr. 58	104.1	131.1	59.2	27.0	71.9	98.9	2.5	4.8	3.8
Apr. 58 – Dec. 59 – Oct. 60	96.4	104.6	101.0	8.2	3.6	11.8	0.4	0.4	0.4
Oct. 60 – Sept. 61 – Oct. 62	99.2	105.8	91.1	6.6	14.7	21.3	0.6	1.1	0.9
Average	86.5	126.6	88.3	40.0	38.1	78.1	2.3	2.2	2.4
Average deviation	16.0	18.0	18.6	31.3	36.4	57.7	1.5	1.8	1.4

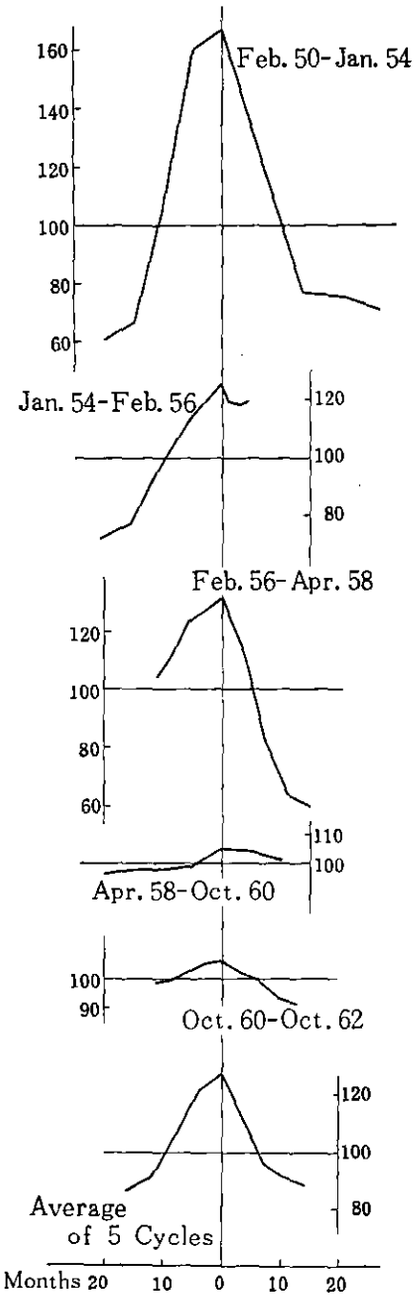
Table 9. The Computation of Specific Cycle Patterns—Voyage Charter Rates (Norway)

Dates of Specific Cycle	Average in Specific Cycle Relatives at Stage								
	3-Month Average Centering on Initial Trough	Expansion			3-Month Average Centering on Peak	Contraction			3-Month Average Centering on Terminal Trough
Trough – Peak – Trough	(1)	Initial Period (2)	Middle Period (3)	Terminal Period (4)	(5)	Initial Period (6)	Midcle Period (7)	Terminal Period (8)	(9)
Feb. 50 – Oct. 50 – Jan. 54	60.8	67.1	106.1	160.2	167.0	122.2	77.0	75.6	70.7
Jan. 54 – Oct. 55 – Feb. 56	72.2	77.7	97.1	113.9	124.3	119.7	119.1	118.7	119.3
Feb. 56 – Jan. 57 – Apr. 58	104.1	111.7	122.4	127.2	131.1	112.0	81.4	63.5	59.2
Apr. 58 – Dec. 59 – Oct. 60	96.4	97.9	97.8	98.7	104.6	104.5	104.1	102.8	101.0
Oct. 60 – Sept. 61 – Oct. 62	99.2	99.6	102.2	105.2	105.8	101.9	99.1	93.6	91.1
Average	86.5	90.8	105.1	121.0	126.6	112.6	96.1	90.8	88.3
Average deviation	16.0	14.7	7.3	18.1	18.0	6.9	13.6	17.0	18.6

Finally, let us consider the cyclical behaviour of shipping freights by analysing the amplitude and pattern of each cycle. Since it has become clear that, although there is a little difference in the way of fluctuation of each index, the indices other than tanker rates move almost in the same manner, we will examine the amplitude and pattern of cyclical fluctuation by taking the voyage charter rates as a representative example of importance. Table 8 shows the amplitude of seasonally adjusted series of Norwegian voyage charter rates considering it as a specific cycle.

Here, the figures (2), (3) and (4) are the percentages which are obtained by dividing the three-month average centering on trough-peak-trough by the average indices of each cycle period, that is to say, the

Figure 4. Patterns of Successive Specific Cycles and their Average Pattern—Voyage Charter Rates (Norway)



three-month average of specific cycle relatives. (5) and (6) are the amplitudes of rise and fall obtained as the difference between the peak and the initial trough and that between the peak and the terminal trough. (7) is the sum of (5) and (6). Per month averages of these amplitudes are (8), (9) and (10). What are noticeable in this Table are as follows: First of all, in the first cycle at the time of the Korean War, both the rising phase and declining phase had large amplitudes, and it is the rising phase in the second cycle and the declining phase in the third cycle that had large amplitudes, whereas in the fourth and fifth cycles, both the rising and declining phases had very small amplitudes. It can be said that this shows the result that the rising power of business was weakened by the excess tonnage after the Suez boom. Besides, it is noted that as a whole, the amplitude of the rising phase got smaller and the lifting power of business became weaker as time went by. But it is expected that the lifting power rises again as the excess tonnage disappears. The fact that the amplitudes of declining phase in the second and fourth cycles were small shows that the decline of business at the declining phase remains slight when there is a trend of long term business improvement.

Now let us also prepare the patterns of specific cycles of Norwegian voyage charter rates (seasonally adjusted series) in order to understand the characteristics of each cycle in more detail. In Table 9, each cycle is divided

Table 10. Amplitude of Specific Cycle—Time Charter Rates (Norway)

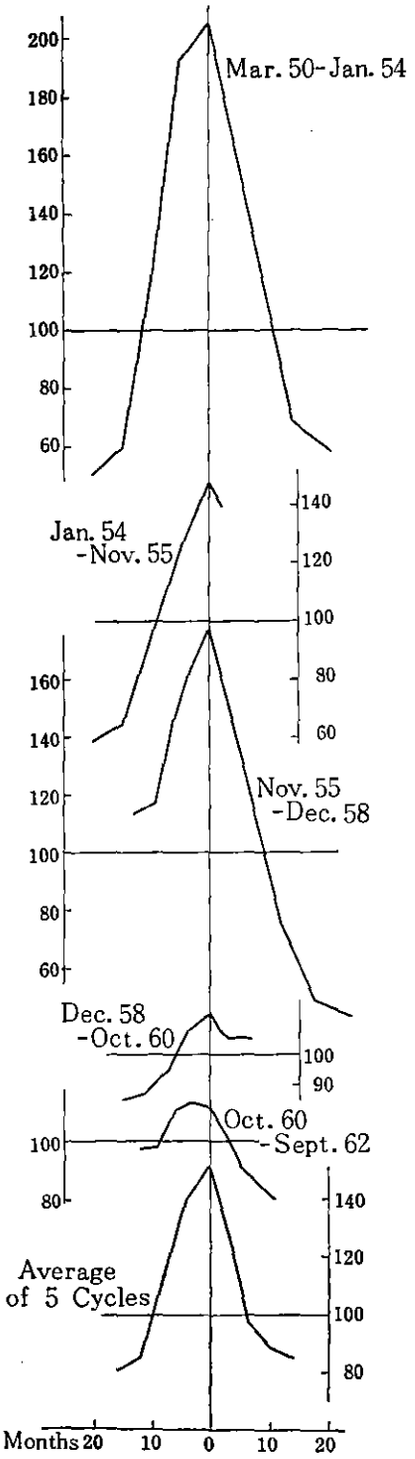
Dates of Specific Cycles	3-Month Average in Specific Cycle Relatives Centered on			Amplitude of			Per Month Amplitude of		
Trough – Peak – Trough (1)	Initial Trough (2)	Peak (3)	Terminal Trough (4)	Rise (5)	Fall (6)	Rise & Fall (7)	Rise (8)	Fall (9)	Rise & Fall (10)
Mar. 50–Nov. 51–Jan. 54	51.0	205.2	53.5	154.2	151.7	305.9	8.1	5.8	6.8
Jan. 54–Sept. 55–Nov. 55	58.6	148.2	140.0	89.6	8.2	97.8	4.5	4.1	4.4
Nov. 55–Dec. 56–Dec. 58	113.8	178.0	43.4	64.2	134.6	198.8	4.9	5.6	5.4
Dec. 58–Mar. 60–Oct. 60	84.7	114.0	105.9	29.3	8.1	37.4	1.9	1.2	1.7
Oct. 60–Oct. 61–Sept. 62	98.0	111.7	80.0	13.7	31.7	45.4	1.1	2.9	2.0
Average	81.2	151.4	84.6	70.2	66.8	137.1	4.1	3.9	4.1
Average deviation	21.1	32.1	30.7	41.4	61.0	92.2	2.1	1.5	1.8

Table 11. The Computation of Specific Cycle Patterns—Time Charter Rates (Norway)

Dates of Specific Cycle	Average in Specific Cycle Relatives at Stage								
	3-Month Average Centering on Initial Trough	Expansion			3-Month Average Centering on Peak	Contraction			3-Month Average Centering on Terminal Trough
		Initial Period	Middle Period	Terminal Period		Initial Period	Middle Period	Terminal Period	
Trough – Peak – Trough	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mar. 50–Nov. 51–Jan. 54	51.0	60.3	117.4	192.2	205.2	133.1	68.8	58.9	53.5
Jan. 54–Sept. 55–Nov. 55	58.6	64.3	95.1	126.4	148.2	146.4*	144.5*	142.3*	140.0
Nov. 55–Dec. 56–Dec. 58	113.8	116.3	145.4	163.0	178.0	124.1	74.3	48.0	43.4
Dec. 58–Mar. 60–Oct. 60	84.7	87.1	95.5	108.3	114.0	109.1	105.9	106.1	105.9
Oct. 60–Oct. 61–Sept. 62	98.0	99.3	111.2	113.9	111.7	102.3	90.2	85.4	80.0
Average	81.2	85.5	112.9	140.8	151.4	123.0	96.7	88.0	84.6
Average deviation	21.1	18.5	14.8	29.5	32.1	13.8	22.8	29.0	30.7

into 9 stages to show its specific cycle relatives. The figures (1), (5) and (9) of Table 9 are equal to the figures (2), (3) and (4) of Table 8. (2), (3) and (4) are the figures of specific cycle relatives obtained by dividing the rising phase into 3 stages, while (6), (7) and (8) are those obtained by dividing the declining phase into 3 stages, (here, specific cycle relatives are the percentage of the average value of each stage to the average value of the cycle in question.) Figure 4 is the graph showing this. As seen, there is a contrast between the second and the third cycles, but this is because we divided the period from the beginning of 1954 to the spring 1958 into two cycles before and after the Suez Crisis. Therefore, if the second and third cycles are combined, a curve which is almost similar to the first cycle may be drawn. Taking this into considera-

Figure 5. Patterns of Successive Specific Cycles and their Average Patterns—Time Charter Rates (Norway)



tion, and if the fourth and fifth cycles against the previous ones are compared, it would be possible to draw the following conclusion: The quicker the increase of business is, the sharper is the subsequent decline and when the recovery of business is slow, the subsequent business recession takes a gentle decline. This may also be put as "The higher the peak is, the deeper the trough is, and the lower the peak is, the shallower is the trough". On the other hand, it is impossible to find a distinctive relation between the business decline and the subsequent recovery.

The same results are found also in the cyclical behaviour of time charter rates. See the Table 10, 11 and Figure 5. It is seen from these that the time rates show the similar cyclical movement as the voyage rates but the former has larger amplitude than the latter. So the cycle pattern of shipping freights is shown more clearly. Besides, we can find the difference between the fourth cycle and the fifth cycle; the rising phase in the fourth cycle has the relatively large amplitude, whereas in the fifth cycle the declining phase has a large one.

Now the above conclusion, say, "the higher the peak is, the deeper the trough is, and the lower the peak is, the shallower is the trough", is known as a classic characteristic of the business cycle. Recently, however, it is often pointed out that many indices of national economy (e.g. national income, industrial production index) have not such characteristics but rather

the opposite one, that is, " the sharper the recession is, the quicker the recovery is, and when the recession is gentle, the subsequent recovery is slow ". As to the price indices, too, their regidity is often noticed. Nevertheless, the fact that the classic characteristics of business cycle are applicable, as they are, even to the post-war cycle of shipping freights, seems to be because the voyage and time charter markets are still now in principle the markets of free competition and the shipping freights are established under the classic structure of price determination. Therefore, as long as the tramp market holds the character of free competition, this pattern can be expected to continue. However, today, particularly after the Suez Crisis, the tramp market has undergone a big structural change by the development of specialized carriers (bulk-carrier, ore-carrier) and the increase in consecutive voyage charter parties which appeared together with the former. Consequently, today, the tramp market as the free competitive market is smaller than before and is becoming a *marginal* market like the free tanker market. It would be very interesting to know what influence such tendency will have on the shipping freights cycle hereafter.

Based on the statistical information obtained by applying the Bureau of Census Method II, we analysed the shipping freights fluctuation from various aspects and found many important characteristics. It would be impossible to expect to obtain more results simply by such analysis. In order to surpass this limit, it is necessary to carry out econometric analysis of the shipping market taking into account the changes of demand and supply factors which bring about shipping freights fluctuation in the world economy. By leading the research in such direction, we could clarify the structure of shipping freights fluctuation. The present research provides some spadework for that study.